

## ABSTRACT

The Last Species is an effort to examine the choices that confront us today that will determine where this nation will be in the year 3000. This presentation addresses the appropriate coordinating role for the National Biological Service, its formation and evolution, and its political liabilities. The latter receives special attention because it fits into the broader national political and environmental arena. A shift in the meaning of critical words and phrases will be singled out as a primary causal agent for the current distress within the scientific community. Some practical suggestions are made on how to engage and educate elected officials and the public at large.

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The sunset is bold, harsh, colored by an acrid, hot atmosphere. The waning sun fails to diminish the heat, absorbed during the long day by a blackened scorched landscape that returns it to the atmosphere with equal force as night falls. A pair of tall pink spires droop and slowly, ever so slowly, come to reside, recumbent, on the coarse sand. Although in full flower, no seeds will result for there are no pollinators except the hot wind. They are destined to dry, to wither, and to die.

What made the earth unique exists no more. The last species is gone and the earth has become only another of billions of lifeless hulks hurtling through the cosmos. Because no eyes are around to witness the final extinction, no one cares. Is this the earthly scene that we want to mark the millennium beginning in the year 3000? I think not. If you agree, then we need to examine the present state of our national affairs and take action to assure a different future.

Many of us are reasonably sure that a meteor collision with the earth caused the last great extinction. For decades, we thought the likely cause of the next major extinction event would be a nuclear war. Remarkably, that seems far less likely today. We appear to be at the beginning of the sixth great extinction, but this time the cause is of an entirely different nature. The threat is human population with its egosystem affecting virtually every ecosystem. If not now, there soon will be too many of us and too many of us doing the wrong things. The number of individuals in a species does not protect that species from extinction; we need only to consider the fate of the passenger pigeon. The United Nations projects that the world population

will grow from 5.6 billion to 11 billion by the year 2045. Most of this growth will be in the developing nations. At the end of World War II there were about 55 sovereign nations—today there are 207 (Anonymous, 1995a). Of these, approximately 90 are exploiting their natural resources beyond sustainability. Political fragmentation is reflected in numerous areas of armed or political contention throughout the world, often pitting one “culture” against another. If we look at the number of dissimilar groups that exist, we should anticipate that this fragmentation and accompanying unrest will only increase.

The United States makes up approximately 4.5% of the world’s population but consumes 25–30% of the resources. Meanwhile, 1.3 billion people live in dire poverty, that is, with less than \$1 a day of income. Consider further what a small percentage of its budget this nation spends on research and it becomes clear why the funding of research has become increasingly difficult. The U.S. spends more than \$350 billion for advertising, exceeding the gross national product of Australia. The value of our arms exports vastly exceeds that of foreign aid. Common sense dictates that we cannot continue on this path over the long term. It is imperative that we acknowledge that all commerce takes place within the parameters of our natural resources. If we fail to make this acknowledgment, and understand and appreciate the limits it places on our actions, we are doomed to self-destruction.

It is clear that the world’s tropical forests are being irretrievably lost, with 69% being converted to marginal agriculture, charcoal, local use, or export to developed nations. Much of the tropical for-

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est is being devoted to the manufacture of plywood in some developed nations. This plywood, in turn, will be used primarily to make construction forms. Closer to home, the oak logs cut in southern Illinois are used primarily to construct pallets. We are losing a vast array of plant and animal species that will remain forever unknown.

The worldwide collapse of fisheries is a fact and is due to overexploitation, various pollution factors, and the application of ill-founded hatchery, stocking, and aquaculture practices. If you do not believe that there is a collapse, check your local market prices and species availability.

Eighty countries (Anonymous, 1995b) have moderate to severe water scarcity, and these countries are home to 40% of the world's population. The global demand for water is estimated to double every 21 years. Irrigation consumes 90% of all water used in poor countries with up to half of it being wasted. It is estimated that 10 million deaths annually are water related. Drinking-water quality is a problem even in this country with federal standards sometimes being exceeded by nitrates and the herbicide atrazine, as well as several other pesticides, in the Midwest (Taylor, 1994). For example, the regulatory level for atrazine is three parts per billion with the highest actual sample level at more than six times the regulatory level. Recent research has shown that DNA modification occurs in hamster tissue at the regulatory level, that is, at three parts per billion (Gunset, 1995).

The organism *Cryptosporidium* is scarcely monitored by water finishers even though it is an increasing problem. A check of untreated intake water in 66 water treatment plants in the U.S. identified the presence of *Cryptosporidium* in 87% of the plants (LeChevallier et al., 1991). The 1993 outbreak in Milwaukee of cryptosporidiosis is estimated to have caused 400,000 illnesses (MacKenzie, 1994) resulting in a loss of \$37,000,000 (Smith, 1995) in unearned wages and productivity.

Given the large number of activities of the biological community that range over an absolute galaxy of interests, some centralized coordination may be necessary if we are to make overall progress in protecting the environment. What others are either unable or unwilling to do is an appropriate and logical function of government. In this case, no one has been able to function as an organizer, so it falls to the government to become the organizer and coordinator.

It might be helpful to briefly review the recent history of a biological survey for the U.S. in order to better appreciate the present political and biological situation.

- 1977. Canadian entomologists begin to plan for a Canadian National Biological Survey. Michael Kosztarab, Virginia Polytechnic Institute and State University, initiates discussions on the need for and utility of a biological survey for the U.S.
- 1982. The Association of Systematics Collections (ASC) endorses the biological survey concept and is soon followed by the endorsement of 28 other scientific societies.
- 1984. A major unscheduled discussion of the biological survey takes place at the ASC annual meeting hosted by the Illinois Natural History Survey.
- 1985. The ASC annual meeting results in the publication *Foundations for a National Biological Survey* (Kim & Knutson, 1986).
- 1986–1992. A bewildering array of meetings with federal agencies and members of Congress takes place. Legislation was drafted but never advanced. A last-minute attempt in 1992 to form the National Biological Survey (NBS) by Presidential Order failed to materialize.
- 1993. Department of the Interior Secretary Bruce Babbitt forms the NBS by Secretarial Order. He also poses a series of questions to the National Research Council (NRC) about the organization and direction the Survey should take. A 19-member committee, under the leadership of Peter Raven, was assembled and issued its report *A Biological Survey for the Nation* in October 1993. This report served as the major guideline for the development of the Survey. One of the stated reasons that Secretary Babbitt formed the Survey was to prevent “environmental train wrecks.” In order to accomplish this he thought it necessary to “develop data that everyone could agree was accurate.” In turn, this would lead to an increase in the quality of natural resource management decisions. In a parallel statement, Illinois Governor Jim Edgar, referring to the three Illinois surveys, stated, “Surveys play a very important role in helping us in government make better decisions because we have the facts from the Surveys.”
- On February 24, 1994, the Association of Systematics Collections and the Department of the Interior entered into a Memorandum of Understanding. As a result, a Systematics Resources Working Group, consisting of representatives of ASC and NBS, together with representatives from the Environmental Protection Agency, National Marine Fisheries of the National Oceanic and Atmospheric Administration, the U.S. Department of Agriculture and, more recently, the



National Science Foundation, entered into a planning process to assist in the implementation of the MOU.

- In June 1994, Ronald Pulliam is named Director of the NBS.

Given all this orderly and logical progression of organization and activities, what changed to place us in our current circumstances, that is, attempting to defend the enforcement of environmental law?

The scientific community was so buoyed up by what we interpreted as positive trends and developments that we became complacent, even self-satisfied, and failed to recognize the controversy that had been developing for many years. The signs were there—some were even discussed at professional meetings—but we did not appreciate the depth of negative feeling toward regulation. Unfortunately, Stan Shetler (1995) may have had it right when he said, “I believe, however, that reaction to federal environmental protection and conservation efforts and the funding of science has been setting in for a long time and that the change in American attitudes about regulations and tax support is not a passing fancy.”

What happened? In my opinion, the language changed. Language is a living, dynamic thing and words do change. In *Through the Looking Glass* (Carroll, 1977), “When I use a word,” Humpty Dumpty said, in a rather scornful tone, “it means just what I choose it to mean—neither more nor less.” “The question is,” said Alice, “whether you *can* make words mean so many different things.” The answer is yes, one can make words mean different things at different times. One technique of developing pejorative meaning in words is demonization, which is a favored format of religious and political leaders. Even a casual examination of the political debates of our time indicates that religion and politics seem to be merging with increasing frequency and ferocity.

Reversing the connotation of a word is accomplished with relative ease through the use of egregious examples based on falsehoods or near-truth. Let me translate a few code-word examples: natural resource abuse = wise use; that science with which exploiters agree = good science; review by the exploiter community = peer review; obstructionist = environmentalist. “Traditional family values” also falls into this category. A little genealogical research by some zealots might convince them that their antecedents were not all that great. An example of our own making is “theory of evolution.” Theory has vastly different meanings for scientists and the general public. This difference in meaning

opened the door for scientific creationism. Another set of catchwords that remains confusing to the scientific community is “ecosystem management.”

My father was always interested in the local St. Louis issues of bribery and graft. After bribery fell out of fashion, he recognized that it was resurrected, legitimized, and institutionalized and called Political Action Committees or PACs. Aside from the protestations of elected officials, is there any reason to think that contributions do not influence legislation? Until this is addressed, that is until PACs are eliminated, legislative power is going to remain in the interest of large contributors to the detriment of the public at large.

As the bill for the National Biological Survey moved through the House of Representatives in 1993, several real or perceived issues surfaced. The very word Survey in the title conjured up in the minds of some representatives swarms of “Audubon Gestapo” sweeping across the nation to find new dickey birds in order to regulate the use of private property. The main issues were access to private property, written permission to access private property, and the use of volunteers. What I am going to do is briefly outline each problem and relate the Illinois experience.

Access to private property is a complex issue in that it is difficult to keep isolated from the Endangered Species Act (ESA). Under the ESA, there has been a number of highly publicized incidents, often untrue, that purport to have “infringed” on individual freedom. The words used in these cases are “unreasonable restraint.” The word of these so-called incidents has spread like ripples on a pond. Mark Twain observed, “A lie is halfway around the world before the truth puts on its shoes.” The fact is that the Fish and Wildlife Service obtained injunctive relief under the ESA only four times in six years (Beattie, 1995).

Governmental regulation is butting heads with a new sense of land ownership rights as perceived and defined by the owners. The perception is that access to private property will lead to new and burdensome regulation which, in turn, is seen as a form of uncompensated land-taking. These sentiments are mostly found in rural areas that have not experienced the regulation, that is, zoning, necessary to make urban areas operable and livable.

Since 1917, the Illinois State Geological Survey, Natural History Survey, and State Water Survey have had authority, in statute (1992 Chapter 96 1/2, ¶ 7403(b)(1)), to enter all lands of the state:

“(1) To investigate and study the natural resources of the State and to prepare printed reports and furnish information fundamental to the conservation and devel-



opment of natural resources and for that purpose the officers and employees thereof may, pursuant to rule adopted by the Department, enter and cross all lands in this State, doing no damage to private property."

The wording has changed slightly over the years, but the overall authority remains intact. Staff are expected to contact landowners prior to entering because a plastic identification card provides little protection against the rare event of physical or armed intervention. After hearing the reasons for entering property, the landowner often accompanies the scientist and actually assists with the research. Thus, a landowner is converted into a volunteer and one with an enhanced understanding of the importance of our natural resources, particularly on his or her property.

Were there any instances of problems? Of course. I had to deal with one that was precipitated by staffers who failed to clear entry with the landowner. The landowners were senior citizens who were frightened by the presence of unannounced persons. Their concern was exacerbated by recent cattle-rustling activities in the area.

The written permission to access private property issue is, at least in part, a liability question. Written permission is one way of being certain of who is on the land, and liability is considerably less in the case of a trespasser. Obtaining written permission prior to gaining access to private property is possible, but only to a limited extent. Why? More and more rural landowners are proving difficult to identify because of the shift of population toward urban and suburban areas or their relocation to other states or other countries. We live in Piatt County, Illinois, a relatively small county that is largely agricultural in nature. The largest landowner is a foreign corporation with the land in the hands of a local manager. In central Illinois, on a per-acre basis, close to 75% is operated by someone other than the landowner (Gucker, 1995). Alaska has 71% of its farmland under lease. The lowest percentage of leased farmland is in Maine, New Hampshire, and Massachusetts with 17 to 23%. Many biological events are of a short duration and may be long over before it is possible to locate the landowner, much less receive written permission.

The efforts of volunteers are not opposed, *per se*. The concern is expressed in each of two steps: data gathered by volunteers may be inaccurate because of a lack of expertise; inaccurate data could be used to formulate policy or additional regulation. The argument basically is that volunteers are not as well trained as professional scientists, and even professional scientists have been known to err from time to time. There is also a concern that volunteers may

have subtle "white hat" prejudices that would influence the data-gathering process.

Early on, the House of Representatives passed an amendment to the NBS bill that explicitly forbade the use of volunteers. This amendment was not in the tradition or practice of the majority of the adult population of the United States. Although some languages do not even contain a word for volunteer, volunteerism is deeply seated in the American way of life. It is often said that approximately 80% of American adults serve as volunteers. If volunteerism was curbed by legislation, how would our organizations prosper? Consider the impact on churches, scouting, 4-H, hospitals, museums, service organizations, even political campaigns! To deny the NBS access to volunteers via legislation was both discriminatory and distinctly unAmerican.

There are numerous positive examples of data-gathering by volunteers in natural history. NBS examples include the Christmas Bird Count, Breeding Bird Census, Atlas Programs, Project FeederWatch, Hawk Migration Data, Adopt-A-Refuge, Save-Our-Streams, Natural Heritage Data, and the Fourth of July Butterfly Count. It is imperative for us to understand the concerns of some, and special measures must be taken. Data gathered by volunteers must be reviewed by professional scientists, anomalies investigated, and occasionally data sets may have to be discarded. All interpretation of data must be made by professionals.

In November 1994, along came the Contract with America (CONWAM) and, suddenly, we were confronting a horse of another color. Environmental leadership from the White House collapsed, the environmentally sensitive Vice President disappeared in a flash of white light, and new leadership emerged in the Senate and the House. As we look forward to the next presidential election, leading presidential wannabes and a third-party hopeful do not hold promise of anything better. It seems as though a fifth Horseman of the Apocalypse should be added—elected officials.

The NBS problem areas became increasingly difficult and on January 5, 1995, in an attempt to dampen overheated sensibilities, Secretary Babbitt changed the name to the National Biological Service. Subsequently, both houses of the Congress terminated the NBS, but the Senate's version of H.B. 1917 transferred NBS programs to the Natural Resources Science Agency. Unfortunately, the Senate version provides that no funds may be used for surveys, including aerial ones, on private property unless with the explicit written permission of the owner.

What must we do to restore the worth of our sci-



ence in the eyes of the public and legislators? I have a few suggestions to offer for your consideration.

We must capture the data held in our collections in such a way as to make it usable and useful to a broad spectrum of users. The National Biological Information Infrastructure (NBII) was conceived precisely to make this possible through interconnectiveness. For nearly a quarter of a century too many in the profession have been dragging their feet and using an inability to devise a commonly agreed-upon data format to justify inaction. Full computerization of collections data cannot wait until my grandson grows up, even though at ten months he has an early start. There has been a continuing debate about the best hardware and software. As the technology becomes increasingly transparent, this is no longer a matter for valid discussion. Concerns do remain—proper specimen identification, for example. I am torn on this point: one side says make the data available, even if it is not robust, because it will get corrected; the other side says get it right. In 1972, I suggested that data entry could be made at the time of loan return, thus assuring a higher than normal level of reliability. Had that been done consistently by all, the entomologists, who are facing a monstrous task, would be further along.

A second problem area, no pun intended, is that of geographic locality. Older collections, where the locality data is obscure or too broadly drawn, may have to be put aside even though they are of immense historical importance. For current collections I see no reason why global positioning systems should not be employed to provide the level of accuracy necessary for GIS applications.

Some members of the Congress would prefer to eliminate not only aerial surveys but also electronic data-gathering. At first, this seems curious, but even with limited reflection it is clear that what they wish to eliminate is incontrovertible evidence. Just as I once said that GIS would blow your socks off, the same is now true of the blending of satellite imagery and landcover analysis. Before the end of the year we expect to have complete coverage for Illinois. We completed a 10-year change comparison for one county and found that the changes were not what everyone imagined. A loss of farmland was projected, but proved untrue; the actual loss was in forested lands.

Lack of electronic, that is, Internet, accessibility provides an additional and major problem for some organizations. Those not on the Internet with a home page are excluded from a major information interchange. If you do have a home page, keep

track of where the queries are originating and the kinds of organizations making the inquiries. For those of us in the governmental realm, it is clear that we must make our data available. Those among you from private institutions may experience a problem at several levels. The curator may wish to make collections data freely available, but the director does not. The director's position is that the institution has an obligation to try to recoup part of its investment in developing the database. This position honors fiduciary responsibility. The reverse situation may occur if the curator refuses to provide collections data. Wayne King refers to this as "curatorial barony." For those among you who believe that your data can be a major source of institutional revenue and that it can support computer operations, you are advised to reconsider for you will experience disappointment. Computer operations are better regarded as part of the infrastructure support necessary to do science rather than as a revenue stream.

The majority of you are systematists and your institution is, I hope, a member of the Association of Systematics Collections. I mentioned the Systematics Resources Working Group (Working Group) previously, and I would like to share some aspects of our first interim report with you. That report will be issued shortly with six recommendations.

The Working Group recognizes the necessity to focus on products rather than process in order to demonstrate the relevance of systematics collections, systematic biology, biodiversity, and biotic inventories. The first recommendation, to establish a home page for ASC, has been accomplished. Two additional recommendations have been implemented by ASC and NBS, the development of a Taxonomic Resource Expertise Directory and a Directory of Research Systematics Collections. Both directories will be available on the Internet through NBII.

The fourth recommendation is to automate essential collections data. The given is that there are insufficient funds to automate all collections data over the short term. The Working Group identified high-priority groups that could serve as demonstration projects for data automation. The high-priority groups are amphibians and reptiles; conifers; freshwater crustaceans; freshwater fishes; mycorrhizal fungi; lepidoptera; lichens; unionid, hydrobiid, and pleurocerid mollusks; nematodes; and orchids. The Working Group fully realizes that this list will not enjoy universal appeal and, therefore, suggests that the list be subject to regular review and revision. It is of interest that the NSF has awarded more than



sixty grants in FY 93 and 94 in these priority groups.

The fifth recommendation is to develop a public document detailing practical applications of systematics as a supplement to Systematics Agenda 2000. Eventually, examples of applications of systematics should be made available on the ASC Home Page. If you would like an outstanding example of efforts along these lines, see *Reinventing Systematics* (Becker, 1995).

The final recommendation is the development of a list of priority needs for training and professional positions. This list will be developed from identified gaps in scientific expertise in critical biological groups with input from the NSF Partnerships for Enhancing Expertise in Taxonomy (PEET).

Look for opportunities to provide baseline information to both the scientific and lay communities. In Illinois we did this through *Our Living Heritage: The Biological Resources of Illinois* (Page & Jeffords, 1991) and *The Changing Illinois Environment: Critical Trends* (Illinois Department of Energy and Natural Resources, 1994). NBS recently did the same in *Our Living Resources* (LaRoe et al., 1995). Once this information is in the public domain it can be used for demonstrating change over time.

The Office of the President appears to have little power beyond that of persuasion and veto. Therefore, it may be foolish to concentrate exclusively on the presidency with regard to elections. It may be far more important to devote energies to congressional elections. Forget party labels and support those that support environmental issues because the current environmental battlefield is the appropriations committees. Be very careful on this point because some may be prohibited from taking advocacy positions, and others may be with institutions that find it unacceptable. Proposed new legislation linking federal grants and advocacy are an added institutional threat (Anonymous, 1995c).

You are required to learn at least the rudiments of politics and the Byzantine pathway that leads to legislation. It is said that lawmaking is similar to sausage making—you should never see it done. It is important to realize that elected officials are interested in science only as a tool to help formulate policy and legislation. You must not ignore the state-level lawmaking because most land-use law is drawn at the state or county level. Lawmaking is complex and politics, or the lack of knowledge, is apparent at virtually every step, and “it isn’t over until it’s over.”

Write, fax, call, or e-mail your elected officials on issues that are important to you. Be persistent.

Check to see if your state has a delegation office in Washington. If it does, find out how to make contact and get to know the staffers. They have systems to contact the state delegation in short order. You may be able to convince them to transmit your message to the entire delegation.

I would like to pause to personally thank the Trustees of the Garden for supporting Peter Raven’s effective advocacy on behalf of a host of biological matters over the years. Their support did not happen by accident, but through Peter’s continuing efforts to educate the Trustees. Peter, for you I offer my first modern-day environmental holy card.

Most of you believe you are educators—educate! If you do not know where to begin, start with 5th and 6th graders. It is imperative to capture their attention before the glands begin to work and they focus on one another. There are a multitude of ways to approach children—exhibits, theater, coloring posters, curriculum development, field trips, and so on. The second priority should be elected officials. Lure them to your institutions and tour the collections—if you cannot attract the legislators, settle for legislative aides. Show them what you have accomplished and share with them what remains to be done. Stress the importance of their ongoing support. Follow up because you need to let them know when something good happens and not just when you desperately need their assistance. Try the same approach on that reluctant dean or vice chancellor for research.

Once in a while you may wish to try an “experimental” field trip. We tried one that examined wetland delineation techniques in a number of different environmental settings. Invitees were a local state legislator, representatives from the Farm Bureau, U.S. Fish and Wildlife Service, the Soil and Water Conservation Districts, U.S. Army Corps of Engineers, and the state Department of Conservation. The learning and understanding process was generated by the field trip participants and not entirely by the trip leaders.

In the end, you must educate everyone. Do not neglect your trustees or board members. Do you need ideas? Walk around this garden because it absolutely abounds in teaching and learning opportunities.

You are familiar with all the reasons for preserving biodiversity, ecosystems, and the environment. They have almost become a mantra and have put some of us in a hypnotic state, even depression, rendering us incapable of action. Our mantra has not worked, not because our reasoning is not logical but precisely because it is. Stephen Meyer (1995) has noted, “The practice of what most academics



consider to be good science is largely antithetical to the practice of politics." It is a lesson that I, and I suspect far too many scientists, forget with astonishing regularity.

We, you and I, are privileged to be participants in the ultimate detective story—understanding the course of evolution of living things. Could there be anything more challenging or more rewarding? I think not. We are also fortunate in that we often have the opportunity to enjoy and appreciate the sheer beauty of the living world. Because we are so privileged and have some higher level of understanding of where the world is headed, we, you and I, have a responsibility level far above that of the average citizen.

Do you want the story to end in desolation, or do you want the next millennium to herald a new sunrise? Tonight, now, I place the responsibility for the shape of the next millennium into your hands.

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